United States
Department of Agriculture

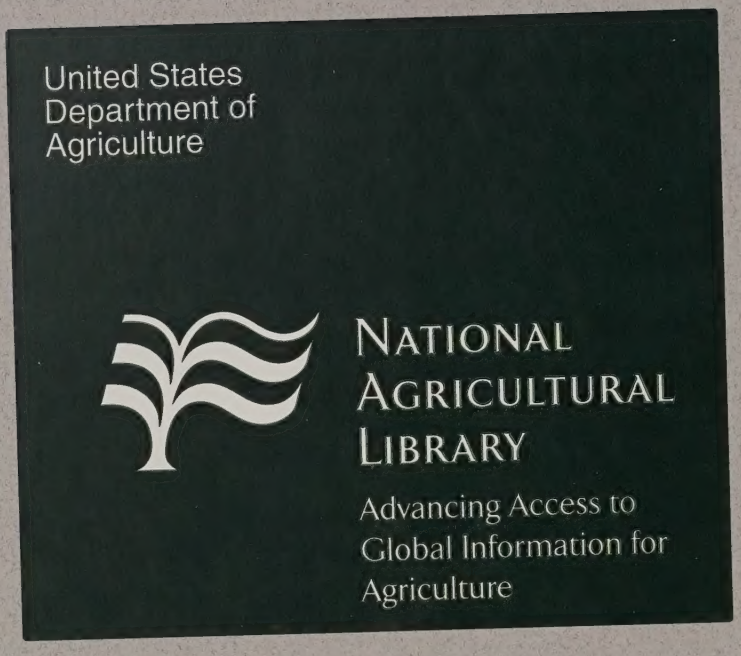
Forest Service

State and Private
Forestry

NATIONAL CENTER OF FOREST HEALTH MANAGEMENT

FISCAL YEAR 1995

1995 ACCOMPLISHMENT REPORT



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Introduction

Our Nation's forests provide a multitude of resources that can contribute to the economic vitality of local and regional communities while providing clean air and water, wildlife habitat, scenic beauty and recreational opportunities for millions of Americans. Maintaining and improving the health of America's forests is a sound investment.

The USDA Forest Service is recognized nationally and internationally as a leader in caring for the land and serving people. It recently adopted a philosophy of ecosystem management which places a greater emphasis on the health of our Nation's forests. The Forest Service Strategic Plan "*Healthy Forests for America's Future: A Strategic Plan*" provides comprehensive guidelines and approaches to achieving the philosophy of ecosystem management.

Strategic Plan

The National Center's Strategic Plan, adopted in June of 1993, describes the Center's purpose, goals, program direction and staffing and areas of work emphasis. The purpose of the National Center is to accelerate the development and adoption of environmentally sound technologies to maintain or improve the health of America's forests.

Goals

The National Center has two goals:

- promote and facilitate the development and application of technologies to sustain or enhance forest health; and
- advance the understanding of the roles of forest health and the impacts of forest health technologies on ecosystem functions.

Work Emphasis Areas

There are four major work emphasis areas:

- Biological Control, including parasites and predators
- Biopesticides, including microbials and semiochemicals
- Non-target Effects of forest health treatments
- Role of Arthropods and Microbials in forest ecosystems

Program Direction

The scope and complexity of the National Center requires an integrated system of management with executive review and oversight. The management structure consisted, at the outset of FY 1995, of a Center Director, Assistant Director - Forest Health Protection, Northeastern Area State and Private Forestry (administrative direction); Forest Pest Management Director, Washington Office (program direction); and a Board of Directors that reviewed and provided guidance to the Center Director.

Board of Directors

Ernest Delfosse, Director, USDA Animal and Plant Health Inspection Service, National Biological Control Institute, Riverdale, MD

Wray Freeman, Division Director, Field Operations Support, South Carolina Forestry Commission, Columbia, SC

T. Michael Hart, Forestry Division Director, Arizona State Land Department, Phoenix, AZ

Robert Lewis, Director, Forest Service Northeastern Forest Experiment Station, Radnor, PA

Anne Lindsay, Director, Policy and Special Projects Division, U.S. Environmental Protection Agency, Washington, DC

Christopher Risbrudt, Director, Ecosystem Management, Forest Service, Washington, DC

Howard Singletary, Director, Plant Industry Division, North Carolina Department of Agriculture, Raleigh, NC

John Walstad, Professor & Head, Department of Forest Resources, Oregon State University, Corvallis, OR.

Changes in 1995

On May 1, 1995, the Forest Health Technology Enterprise Team (FHTET) was established as the first Forest Service-sanctioned enterprise team under Forest Service restructuring. The purpose of the FHTET is to provide forest health technologies which are integral to forest ecosystem management. The concept of the Enterprise Team is to move away from the classic bureaucratic structure and toward a self-managed team.

The FHTET is comprised of three Forest Pest Management Washington Office detached units -- the Methods Application Group (Ft. Collins, CO), the Pesticide Application Group (Davis, CA), and the National Center. Outcomes expected from creation of the FHTET include: increased productivity, efficiency and customer satisfaction; elimination of duplicated services; enhanced service delivery; better utilization of sophisticated equipment; coordinated technology development and transfer functions; and ultimate reduction of component unit staff size.

The general program work areas of the FHTET include:

- *Information Services* (i.e. information retrieval, informational letters, database construction)
- *Technical Support Services* (i.e. model runs, airborne video, photo missions, data visualization, photointerpretation)
- *Training and Education* (i.e. certification and continuing education, FS national training, skill refresher courses, manual preparation)
- *Technology Development* (i.e. coordinate FS Technology Development Program (TDP) and National Agricultural Pesticide Impact Assessment Program (NAPIAP) efforts, develop and support pest and decision support models, improve pesticide application methods)
- *Method Improvements* (i.e. biological control, biopesticides, non-target impact studies, role of arthropods and microbials in ecosystem health, environmental fate studies)

These general work areas are carried out at the following FHTET locations:

FHTET - Ft. Collins

- Decision Support Systems
- Pest Impact Models
- Data & Information
- Data Visualization
- Values

FHTET - Davis

- Pesticide Application
- Dispersion Models and DSS
- Environmental Fate Studies

FHTET - Morgantown

- Biological Control
- Biopesticides
- Non-target Methods
- NAPIAP
- Arthropods/microbials

Management Structure

The management structure of the National Center (now known as Forest Health Technology Enterprise Team - Morgantown) still includes a Director, but the unit now receives both administrative and program direction from Forest Health Protection, Washington Office. The Director, together with the directors of the other two component units of the FHTET and a Team Leader, serve as the Leadership Team for the FHTET. The National Center's Board of Directors has been redesignated as the

FHTET Steering Committee, reviewing FHTET activities and providing recommendations to the Team Leader and Directors.

Staffing

The staffing of the Forest Health Technology Enterprise Team - Morgantown consists of the following positions and individuals:

Center Director	Allan T. Bullard
Program Manager	Richard C. Reardon
Secretary	Lisa F. Cress

Additionally, position descriptions have been prepared and are in classification for two additional Program Managers. The final staffing for the unit will include a program manager for biological control and biopesticides, a program manager for pesticides and non-target effects and a program manager for ecosystem and forest health.

Completed Projects

Emphasis Area: Biorational Methods

❶ Gypsy moth mating disruption using disparlure

Principal Cooperators:

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The objectives were: (1) to provide two efficacious commercial slow release formulations containing racemic disparlure for managing low-density building gypsy moth populations, and (2) to identify the most cost effective and efficacious dose, application rate, and tank mixes for the two commercial products.

Two commercially produced formulations of racemic disparlure (Disrupt II - Hercon and Decoy GM - Biosys) are now available for operational use. Carriers and application equipment were developed for both formulations. The Disrupt formulation is a plastic laminated flake applied once and is registered by the US-EPA whereas Decoy GM is a polymeric bead applied twice and a petition for registration has been submitted to US-EPA. Both formulations have been shown efficacious at equivalent doses.

Funding: FY 1993: $70,000.
FY 1994: 75,000.
FY 1995: 30,000.
25,000. (other source)

❷ Method improvements for the nucleopolyhedrosis virus product Gypchek

Principal Cooperators:

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The objectives were: (1) to identify the most cost effective and efficacious dose and application rate of Gypchek and (2) to develop a ready-to-use carrier for Gypchek.

Gypchek is applied at 0.5 or 1.0 gal/acre/appl for 2 applications at 2×10^{11} OB/acre for suppression projects and at 5×10^{11} OB/acre for suppression projects. A commercially produced carrier (038) (Novo, Inc.) is now available through Abbott Laboratories. Laboratory and spray tower evaluations were conducted to identify potential stickers for carrier 038.

Funding: FY 1993: $50,000.
FY 1994: 50,000.
FY 1995: 21,000.
28,560. (other source)

❸ Develop insect growth regulator Tebufenozide for managing forest defoliators

Principal Cooperators:

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The objective was to acquire efficacy, residue and environmental fate, and non-target impact data for the growth regulator Tebufenozide.

The growth regulator Tebufenozide (commercial formulation Mimic 2F) was evaluated for efficacy on small (less than 100 acre) plots in Ohio (1994) and in Virginia (1995). The 2F formulation applied at 0.06 lb AI/acre in gal/acre for 1 application is recommended for pilot testing. Evaluations were conducted in 1994 and 1995 in the plots established in Ohio to determine potential impacts to selected non-target organisms. Mimic caused significant reduction of some species of macrolepidopterous larvae. In the laboratory, Mimic reduced populations of some aquatic macroinvertebrates but only at high doses that would not be encountered in forestry applications. Foliage, litter, soil and water samples were collected periodically in 1994 and 1995 and analysis for residue levels completed in 1996.

Funding: FY 1994: $41,000.
FY 1995: 32,000.

❹ Develop a technology transfer package for Swath Kits

Principal cooperator:

Steve Maczuga
Department of Entomology
Aerial Application Technology Lab
The Pennsylvania State University
University Park, PA 16802

The objectives were: (1) to provide on-line technical assistance concerning the maintenance and upgrades of hardware/software for Swath Kits, (2) to troubleshoot and 'beta test' a Windows™ compatible version of the Swath Kit and to upgrade the hardware in existing Swath Kits to enable the Windows operating system to be run, (3) to continue to publish the "Swath Kit News", a bi-annual informational newsletter giving news, advice and technical bulletins on the Swath Kit, and (4) to construct an Internet World Wide Web site as a repository of information on the Swath Kit.

The results of this project (by objective) were: (1) On-line technical support of the Swath Kit continued in the past year. Problems and questions involving spread factors, equipment malfunctions, and calibration were the most frequently asked. (2) The 'beta testing' of the new Swath Kit for Windows software is nearly complete with only a few minor problems remaining. The main thrust of all of the objectives has been the hardware upgrade of the existing Swath Kits. Many of the Swath Kits in use were 286 or 386 machines which are incapable of running Windows software in a timely fashion. The 286 machines have been stripped for salvageable parts. Three new units have been acquired to replace the 286 units and additional equipment has also been acquired to upgrade all other cooperator Swath Kits (Forest Service, APHIS, and state). All but one of the Swath Kit upgrades have been completed. In addition, all cooperator Swath Kits are now capable of using a VGA or EGA monitor with the portable computer system to allow for Windows software to be used to its fullest extent. (3) The publication of the "Swath Kit News" is continuing. The fall 1995 issue was released and mailed out at the end of September 1995. (4) The construction of the World Wide Web site is complete and available through the Forest Service server in Morgantown, WV or through the Penn State server at University Park, PA.

Funding: FY 1995: $35,000.

Emphasis Area: Biological Controls

❶ Coordinate International efforts with USDA-APHIS and - ARS and IIBC to locate, evaluate, and distribute potential biological control agents for managing forest and urban pests

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The 1995 objectives were: (1) to conduct a literature search for known hosts of *B. schineri* (a tachinid parasite of the gypsy moth in Europe), (2) to determine oviposition cues used by *B. schineri*, (3) to develop list of non-target hosts in cooperation with regulatory officials and environmental specialists, (4) to make collections of non-target hosts, and (5) to conduct host specificity testing in quarantine.

The results of this project (by objective) were: (1) the literature search revealed only two other hosts, *Endromis versicolora* and *Dendrolimus sibiricus*, suggesting a narrow host range. These host genera are not present in North America. (2) Cues required for oviposition by *B. schineri* were tested by offering females bouquets of red oak as follows: intact leaves, simulated feeding (leaf edges notched with a cork borer), leaves previously fed upon by larvae of *L. dispar*, and leaves with tethered feeding caterpillars of *L. dispar*. The distribution of eggs on bouquets for different treatments suggested that oviposition by females was biased with 7.7% on bouquets with untreated leaves, 13.5% on bouquets with simulated feeding, 38.5% on bouquets with feeding by *L. dispar* and 40.4% on bouquets with tethered larvae of *L. dispar*. (3) A list of 44 candidate species of Macrolepidoptera in 11 families for host specificity testing was developed. Emphasis was placed on Lymantriidae and related families in the Noctuoidea. (4) Over 20 species of Lepidoptera were obtained for rearing/hibernation Most of these will be used for host specificity testing in 1996. (5) Oviposition choice tests using gypsy moth and five other novel species (*Malacosoma americanum*, *Chaetoglaea sericea*, *Lithophane grotei*, *Amphipyra pyramidoides*, and *Seriglacea signata*) were conducted. The results were not consistent across all experiments, and accidental ingestion of eggs of *B. schineri* in the field by non-target hosts might be possible.

Funding: FY 1995: 5,000.

Ongoing Projects

Emphasis Area: Biorational Methods

❶ Protection of Red Cockaded Woodpecker cavity trees from Southern Pine Beetle with a Novel host compound (4-allyanisole) as bark beetle repellent

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The objectives are: (1) to determine the efficacy of 4-allyanisole (4-aa) for protection of high value stands or individual trees from death due to bark beetle infestation, with particular emphasis on red cockaded woodpecker (RCW) cavity trees (RCW is a federally listed endangered species), and (2) to develop an improved delivery system and application technology for 4-aa.

From October - February FY 93-95, three treatments [all cluster (active and inactive) trees were treated with 4-aa, half of the cluster trees were treated, or no trees were treated] were randomly assigned to 30 clans in predominately longleaf pine habitat on the Vernon RD, KNF. Additionally in FY95, 19 clusters in predominantly loblolly/shortleaf pine habitat were treated [all cluster trees (n=10) or no cluster trees (n=9)] on the Homochitto, RD, Miss. NF. Relatively little SPB activity has been reported on the Vernon RD, and within the experimental clans no cavity trees on the Vernon RD were infested by SPB. Over the same period, SPB activity on the Homochitto RD has grown to outbreak conditions in FY95, and there has been significant RCW cavity tree mortality caused by SPB. In the experimental clusters, SPB did not attack any trees that had been treated with 4-aa, while a total of 8 untreated cavity trees were killed during the period of the study, one each of longleaf and shortleaf and six loblolly. This study is currently being repeated, with an increased emphasis of cavity trees protection on the Homochitto RD and other high SPB activity sites.

Operational experimental use of 4-aa for protection of high value trees from bark beetle infestation has been extended across the South in both conventional forest and the urban environments. For example, as a result of an outbreak of SPB in peninsular Florida, 46 RCW cavity trees have been treated since April 1995 in threatened clusters on the Osceola RD.

Funding: FY 1993: $35,000.
FY 1994: 30,000.
FY 1995: 35,000.

❷ Initiate registration process for Douglas-Fir Tussock Moth pheromone for mating disruption

Principal Cooperators:

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The objective is to obtain registration of the Douglas-fir tussock moth (DFTM) pheromone for use in managing low density, building populations of DFTM.

This project is "on-hold" pending a recommendation from the western Forest Health Regional Directors and Western Defoliator Steering Committee.

Funding: FY 1994: $-0-
FY 1995: -0-

❸ Biology, life history, and population dynamics studies of hemlock woolly adelgid (HWA)

Principal Cooperators:

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The objectives are: (1) to conduct a life table analysis of hemlock woolly adelgid (HWA) on eastern hemlock in southwest Virginia, and (2) to initiate development of a model of HWA population dynamics on eastern hemlock in southwest Virginia.

The results of this project (by objectives) were: (1) In June 1994, four sampling sites were established in four counties of southwestern Virginia. Sites varied in elevation (420 to 625 m) and/or aspect (southwestern to eastern). A Campbell CR10 datalogger (Campbell Scientifid, Logan UT) was placed at each site and is recording hourly temperatures. At weekly, or twice monthly intervals, three equally spaced branch samples of at least 25 cm length are removed from the mid-crown of each tree at each site. Each sample is examined under a dissecting microscope and the number of each HWA life-stage per cm is recorded on a minimum of 20 cm of twigs of each of current, 1-year old and 2-year old foliage. (2) An existing model was selected that enabled estimates of stage-specific durations and survival rates. Three important modifications were made to the model to incorporate the specific requirements of our HWA life-table analysis: (a) a time-dependent distribution of egg laying activity results in multiple cohorts and extensive overlapping of life-stages, (b) simultaneous development of the progrediens and sexuparae life-stages occurs, but they are unequally represented, and (c) fecundity is estimated.

Life table parameters are being estimated via maximum likelihood estimation of model parameters. Life-table analysis will include the correlation between foliage age and stage-specific durations, survival rates, and relative abundance of progredien and sexupara life-stages. The effects of temperature and foliage age on life-table parameters will form the basis of our initial population dynamics model.

Funding: FY 1994: $89,780.
FY 1995: 7,400.

Emphasis Area: Biological Controls

❶ Coordinate biological control efforts to manage Cypress Aphid in Kenya

Principal Cooperators:

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The objectives are: (1) to locate, collect, and rear parasites and invertebrate predators of the Cypress aphid from populations in North America, Mexico, India and Pakistan, and (2) to ship these parasites and invertebrate predators to a quarantine facility in England; subsequent release in Kenya.

In 1994, parasites and predators were collected in Colorado and shipped to the International Institute of Biological Control headquarters in Silwood Park, London. Due to inclement weather during proposed collection times in proposed search areas in 1995 no aphids were found.

Parasites previously collected in Europe are presently being screened and released near Nairobi, Kenya. First indications are that these lab-reared specimens are establishing.

At this time, no funds are available for 1996; therefore, parasite, predator, and aphid collections will continue in Colorado as part of our regular insect and disease surveys.

Funding: FY 1994: $20,000. (other source)
FY 1995: 20,000. (other source)

❷ Develop biological control programs with The People's Republic of China: mealybug, *Oracella acuta*, on slash pine in Quangdong Province

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The objectives are: (1) to establish and/or identify high populations of *Oracella acuta* in pine plantations in Georgia from which to collect natural enemies, (2) to identify the major parasitoids and predators (see (1) above) that may be used in a biological control program in the People's Republic of China (PRC), and (3) to collect and ship natural enemies to the PRC for establishment in quarantine and eventual release into the field.

The results for this project (by objective) are: (1) Mealybug infestations were located in plantations and in seed orchards. Collections were made to check for the presence of natural enemies. Additionally, plantations in Texas and Georgia were sprayed to encourage mealybug populations by temporarily eliminating natural enemies. Numerous collections have been made and at least three species of parasitoids have been collected. Additionally, mealybug infestations have been established on saplings in a greenhouse in order to rear natural enemies. (2) The parasitoids identified so far are *Allotropa* sp., *Aacerphagus* Sp. and *Chartocerus* sp.. *Allotropa* is much more common than the other two species. Several hundred specimens have been reared or shipped to the PRC in mummified (parasitized) mealybugs. (3) Five shipments of natural enemies have been made so far, consisting of live adult parasitoids or parasitized mealybugs. From the first four shipments, 222 parasitoids emerged successfully of which 162 were *Allotropa*. Information is not yet available on the 5th shipment. All three species of parasitoids have been successfully reared in the quarantine lab in the PRC. Some field releases have been made but no data are yet available on survival and/or establishment.

Funding: FY 1994: $42,000.
FY 1995: 7,100.
45,000. (other source)

❸ Develop a biological control program for the woodwasp *Sirex noctilio* in South America

Principal Cooperators:

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The objectives are: (1) to coordinate the development of a biological program for *Sirex noctilio* including the establishment of a natural enemy complex for minimizing damage caused by this pest species, and (2) to provide training of forest scientists from several South American countries in biological control and monitoring techniques for *S. noctilio*.

In early 1995, a 4-year biological control project proposal was prepared by EMBRAPA, the National Center of Forest Health Management and IIBC and sent to several donor agencies for consideration for funding. Although discussions about future funding are still on-going, plans are now well advanced to utilize existing funding to support a biological control training course and the importation of a parasitoid in 1996. Parasitoids will be obtained from one or more of the state departments of forests in southern Australia.

Funding: FY 1994: $24,609.
FY 1995: 12,000.

❹ Establishing natural enemies of hemlock woolly adelgid (HWA) in North America

Principal Cooperators:

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The objectives are: (1) to develop methods to rear predators of HWA for release, (2) to design standard protocols to sample HWA and predator populations, (3) to release, to determine the effectiveness of, and to establish natural enemies of HWA, and (4) to develop an effective biological control program for HWA.

Studies in Connecticut have shown that *Diapterobates humeralis* (an oribated mite) has at least two broadly overlapping generations per year and the life stages consist of the egg, larva, protonymph, deutonymph, tritonymph and adult. Adult mites can live for 10 months with females each producing about 20 eggs at a time. Its low fecundity combined with the difficulties encountered in maintaining a viable laboratory colony for field releases has hampered the evaluation of the mite for biological control. The situation is further complicated by the occurrence of native North American *D. humeralis* which has been found in Connecticut but not necessarily in adelgid infested areas due to the absence of previous sampling. A survey was conducted in 1995 throughout Connecticut and along a 150 km transect in Virginia to determine the distribution of native populations of the mite in relation to adelgid infestations: processing of the samples has yet to be completed. To date, there have been several releases in small quantities of *D. humeralis*, with some preliminary indication of overwintering during the severe winter weather of 1993-1994.

Pseudoscymnus new species (a coccinellid beetle), with its targeted attack of HWA, has clearly evolved as a specialized predator-prey system in Japan and appears to be the most promising biological control agent for study. Experience in Connecticut has shown that the coccinellid is amenable to mass culturing on live *A. tsugae* collected from the field. Preliminary laboratory indications are that the coccinellid may feed on other adelgids it encounters, such as *Adelges cooleyi* and *Pinius strobi*, but preference tests have still to be conducted. This ability to feed on other adelgids may prove to be an adaptive strategy in times of *A. tsugae* scarcity. The life cycle of *Pseudoscymnus* new species is extremely well synchronized with that of HWA, a fact that is enhanced by the production of a second generation in the summer for maximum impact. Adults and larvae attack all stages of *A. tsugae* available. This is an added advantage over other predators which target only the eggs. Dormant first instar. *A. tsugae* nymphs are also consumed during the summer by adults and larvae, which increases and sustains the impact of predation on adelgid populations.

Funding: FY 1994: $92,000. (other source)
FY 1995: 45,000.

Emphasis Area: Non-target Effects

❶ Determine non-target impacts from insecticide applications and gypsy moth defoliation

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The objectives are: (1) to collect baseline data on Lepidoptera, insect pollinators and other selected herbivorous, predaceous, and parasitic arthropods, songbirds, and terrestrial salamanders on plots representing gypsy moth susceptible forest type on the Monongahela and George Washington National Forests, (2) to evaluate the impact of three application regimes of *Bacillus thuringiensis* var. *kurstaki*, gypsy moth defoliation and Gypchek positive controls on the herbivorous, predaceous and parasitic arthropod communities and selected insect pollinators and to evaluate the impact of arthropod perturbations on selected species of songbirds and terrestrial salamanders, and (3) to identify the best indicator communities or species among the herbivorous, predaceous and parasitic arthropods and pollinating insects for evaluation of *Bt* and defoliation.

This study began in July 1994. In the first year, 18 200-ha study plots were established on the George Washington and Monongahela National Forests. Initial data on vegetation composition and gypsy moth egg mass density was collected.

In 1995, the first full year of pretreatment arthropod, bird and salamander sampling was conducted. For arthropod studies, the following sampling methods were utilized on the 18 plots: one blacklight trap per plot operated one night each week; 12 banded trees (oaks, maples and hickories) per plot (216 for the study) sampled weekly; five 21 branch tip samples of foliage per plot per week, two Townes-type Malaise traps per plot operated continuously, sampled weekly and 18 pitfall traps per plot (325 for the study) sampled weekly. Sampling was conducted weekly from May 8 through August 15, 1995. All Macrolepidopterous moths from 270 light trap samples have been identified and data entry has begun. Initial sorting and family identification of 3,240 canvas band samples is 65% completed. Initial sorting of 4,860 pitfall samples and 540 Malaise trap samples is underway. All caterpillars from 1,300 foliage samples have been identified; data entry will soon begin. Other foliage arthropods are currently being sorted.

Additional data were collected on vegetation characteristics on central 30 ha core plots within each 200 ha plot. Canopy cover, shrub cover, ground cover, density of small trees, slope and aspect were measured at sample points. Yearly vegetation studies will enable assessment of impact of gypsy moth defoliation.

Significant numbers of nests of seven species of birds that rely on caterpillars were monitored during the nesting season (total of 234 nests). One-hundred red-eyed vireos were color-banded on Monongahela National Forest plots to assess movement of the birds. Foraging and territorial behavior were measured. Comparisons are being made of vegetation around nest sites (180 to date) to compare effects of defoliation on reproductive success of five songbird species. Predator density was also estimated within core plots.

Salamander study transects were set up within the 18 core subplots. Arrays of 12 wooden boards were placed at 12 locations within each subplot (2,592 boards for the study). Salamander surveys were conducted monthly through October. Six species of salamanders are being monitored under the boards. Data being collected on salamanders include snout vent length, cranial width, weight and sex. Soil pH, soil moisture and leaf litter data are being collected in the vicinity of the board arrays on each subplot.

Funding: FY 1994: $620,000. (other source)
FY 1995: 15,000.

❷ Develop a database concerning impacts of biological insecticides to non-targets in forest ecosystems

Principal Cooperator:

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The objective is to develop and maintain an electronically accessible database on the documented non-target impacts of biological insecticides when applied to forest ecosystems.

A list of potential cooperators and their current non-target activities have been developed for North America. Several databases have been searched and a bibliography is nearing completion which will provide the basis for additional efforts with cooperators. An organizational meeting was held during the Annual Gypsy Moth Review and a research associate from Lake Superior State University has joined the effort.

Funding: FY 1994: $-0-
FY 1995: 20,000.

❸ Monitor non-target Lepidoptera as part of the North Carolina Asian Gypsy Moth Eradication Project

Principal Cooperators:

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Donna Leonard
USDA Forest Service, FH
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The objectives are: (1) to monitor treated (*Bt*) and non-treated (Gypchek or no treatment) paired plots established in unique habitats and habitats of special concern, (2) to develop a checklist of lepidopteran species from southeastern North Carolina that are found in unique or special concern habitats, and (3) to provide voucher specimens for the entomology collections at North Carolina State University in Raleigh and North Carolina Nature Conservancy.

The 1995 results were: (1) paired sites at Bald Head Island, Motsu-Sunny Point terminal and Carolina Beach State Park were monitored weekly from March through November. The same sampling schedule also was used to monitor the Fort Fisher and Peter's Point sites as well as a new treatment site at Half Hell Swamp in Brunswick County, unique habitats at Greenbank Bluff in Brunswick County (coastal plain marl outcrop), and four sites at Holly Shelter Game Preserve in Pender County (swamp forest, pine flatwood and savannah sites outside the spray zone). Preliminary results indicate that no lasting effects of the 1994 *Bt* spray program are apparent. However, efforts to sample caterpillars, as done in 1994, were unsuccessful because they were not present in sufficient numbers to obtain meaningful results (treated or untreated areas). (2) numerous additions have been made to the checklists particularly from the Greenbank Bluff and Pender County sites. The fauna at the 1994 sites was largely unchanged in species composition in 1995. Many of the new species represent significant range extensions from Florida. (3) hundreds of specimens representing species new to the entomology collections at North Carolina State University and North Carolina Nature Conservancy have been and continue to be prepared and deposited at these institutions.

Funding: FY 1994: $89,600. (other source)
FY 1995: 30,000. (other source)

New Projects

Emphasis Area: Biorational Methods

❶ Inventory of semiochemicals for forest and shade tree pests in North America

Principal Cooperator:

Wayne Berisford
Department of Entomology
University of Georgia
Athens, GA 30602

The objectives are: (1) to develop an inventory of semiochemicals of forest and shade tree insect pests in North America, (2) to assess the status of each semiochemical in regard to uses in forest pest management, and (3) to produce a publication which lists and describes uses for these semiochemicals and suggests priorities for their development.

The results of this work (by objective) are: (1) the literature on forest insects has been surveyed and copies of pertinent articles have been compiled and titles and abstracts have been listed on computer disks for easy access, (2) the status of pheromone identification and current and potential uses are being extracted from the literature. A listing of each forest insect, chemical identifications of pheromones, enumeration of each current use and status relative to registration are being noted, (3) a manuscript will be prepared at the culmination of the project and reviewed by selected experts in the field prior to development of the final document for publication.

Funding: FY 1994: $35,527.
FY 1995: -0-

❷ Overview of the status for development of microbials and nematodes for forest and shade tree pests in North America

Principal Cooperator:

James Fuxa
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Louisiana State University
Baton Rouge, LA 70803

The objective is to prepare a report on the potential for using microbials and nematodes to manage the major forest and shade tree pests in North America.

The writing to date has been organized into a preface, a section about criteria for selecting microbial control agents for different approaches to control, a review of pest status (brief coverage of factors relevant to microbial control, in bullet style) and entomopathogen literature (narrative style) for each pest, and a prioritized recommendation for microbial control agents for each pest.

A list of North American tree pests was selected for possible inclusion in this project, based to a large degree on a related USDA/FS project (Van Driesche, University of Massachusetts). Our list includes 169 insect species organized into 14 pest categories. A search of the scientific literature has been completed for these 169 species. A total of approximately 550 publications has been collected. These publications include research of entomopathogens for approximately 75 of the 169 pest species; no literature could be found for the remainder of species. A rough draft of the pathogen review section of the publication has been completed. Editing of this section is in progress, and the other sections are only in the very initial stages of work.

Funding: FY 1994: $30,000.
FY 1995: 12,000.

❸ Develop quality assurance/quality control (QA/QC) standards for pheromones

Principal Cooperator:

As of 12/95 - several private companies and the USDA Agricultural Research Service have expressed an interest in developing QA/QC procedures

The objectives are: (1) to develop a series of QA/QC standards to be implemented as a component of all efforts involving pheromones for monitoring and managing forest and shade tree pests, and (2) to apply these standards to pheromones currently being used for monitoring and managing forest pests.

Several private companies as well as the USDA - Agricultural Research Service have expressed an interest in developing the QA/QC procedures as well as to evaluate these standards on the pheromones currently being used in forestry.

Funding: FY 1995: $-0-

Emphasis Area: Biological Controls

❶ Coordinate efforts with USDA-APHIS and -APHIS Biological Control Institute and International Institute for Biological Control to locate, evaluate and distribute potential biological control agents for managing forest and urban pests

Principal Cooperators:

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USDA-ARS
Beneficial Insect Res. Lab
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Ernest Delfosse
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National Biological Control Inst.
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Silwood Park
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Ascot, Berks
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The objective is to cooperatively fund a project that involves the use of classical biological control to manage a forest pest.

A meeting is held at the Gypsy Moth Interagency Research Forum (mid-January each year) with representatives from each agency and a project selected.

Funding: FY 1995: $5,000.

❷ Biological control of noxious weeds in forest ecosystems

Principal Cooperators:

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James Olivarez
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Forest and Rangeland Management
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P.O. Box 7669
Missoula, MT 59807

The objective is to acquire knowledge on the current status of the use of biological controls to manage noxious weeds in the forest environment (initial emphasis on R-1, Northern Region).

In 1995, contacts were made with 19 national forests in Region 1 and the northern half of Region 4 (the states of Idaho and Montana), to identify which forests and ranger districts may have been involved in biological control of forest weeds. The survey indicated that 48 of the 75 ranger districts that responded had at one time attempted biological control of weeds by releasing one or more biocontrol agents. Most Forest Service records are not available pre-1985. Review of the records of USDA, APHIS, ARS, as well as researchers at Montana State University, the University of Idaho, and their state Departments of Agriculture, indicate that earlier programs included release of agents on national forest lands against klamath weed in the 1950's and 1960's, spotted knapweed in the 1960's and 1970's, and musk thistle in the 1970's (one agent).

The 48 ranger districts that cooperated in the survey reported that a total of 384 releases occurred between 1985-1994, and an additional 190 releases were made in 1995. 225 of the releases were made against leafy spurge, 242 against spotted knapweed, 21 against Canada thistle, and 3 each against klamath weed, Dalmation and/or yellow toadflax, and yellow starthistle. The most striking finding of the survey was that of the total 574 releases on which records could be found, probably fewer than 10% had any follow-up monitoring to determine whether the agents became established, and if so, whether they were impacting the targeted weed.

Information collected during this survey and experience gained is being used to prepare a standard release form and survey format to document future releases on national forests in the West. Efforts have begun to develop a computer database in which this and future data can be stored.

Funding: FY 1995: $6,000.

❸ Develop a pest management program (emphasis on biological control for *Tomicus piniperda* (Common Pine Shoot Beetle))

Principle Cooperators:

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The objectives are: (1) to develop and test an integrated pine shoot beetle (PSB) management program for pine Christmas tree fields, (2) to evaluate the effectiveness of this program for controlling PSB populations in Christmas tree fields, and (3) to begin evaluation of interactions among PSB, native bark beetles and potential biocontrol agents.

A management program that emphasizes cultural practices to trap out emerging adult beetles and eliminate potential brood material was developed by McCullough and Sadof. The program was implemented in Scotch pine Christmas tree fields in Michigan and Indiana in 1995. Surveys were conducted in all fields in spring to determine if trees had been infested by PSB in 1994, and to determine if 1995 trap logs were infested. Most fields had some evidence of previous PSB infestation and many fields and infested trap logs. Surveys of trees in late summer found that when management practices were correctly implemented, PSB populations were either very low or could not be detected. Similar surveys were conducted in Scotch pine fields where the management program was not followed. Damaged and infested shoots were apparent in these fields. Cooperators will meet in 1996 to review 1995 data and revise the IPM recommendations. The revised IPM program will be implemented in Michigan and Indiana fields in 1996, and surveys of shoots and trap logs will be repeated. Data from 1995 and 1996 will be used by state and federal agencies for development of a PSB compliance program that could be implemented in all quarantined states.

Scientists at the Niles Biocontrol Lab initiated a survey of potential natural enemies of PSB in Michigan and surrounding states in 1995. Logs infested with PSB were periodically collected, returned to the Niles Lab, and apparent biocontrol agents recovered or reared to adult emergence. Identification of these insects is in progress. Necessary permits and equipment were acquired by the Niles Lab to import and rear a European Clerid. This Clerid beetle may eventually be released in the North Central region for PSB biological control.

Forest Service and MSU cooperators began preparations to study interactions among PSB, the native *Ips pini* bark beetle, and native bark beetle predators in 1996. A research plan for 1996 is under development and field sites and equipment are being acquired. Both field and laboratory studies will evaluate phenological synchrony of the bark beetle species, the exotic Clerid and a native Clerid species.

Funding: FY 1995: $43,068.

❹ Integrated control of *Cylindrocladium* root disease by using ectomycorrhizal fungi in combination with the microorganisms, a cover crop and soil amendment

Principal Cooperators:

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The objectives are: (1) to determine the species (strain) of ectomycorrhizal fungi, and (2) its effectiveness in the combination with other treatments for suppression *Cylindrocladium* root disease and promoting seedling growth.

A series of plots have been established at a nursery which is maintained by the Pennsylvania Bureau of Forestry. A portion of the plots have a history of *Cylindrocladium* root disease as determined by nursery records and pretreatment soil samples.

Soil samples were collected, processed and incidence of infection as well as species of ectomycorrhizae identified. Laboratory experiments using several of the treatment combinations have been initiated.

Funding: FY 1995: $40,100.

Emphasis Area: Non-target Effects

❶ Develop guidelines to determine non-target effects on Lepidoptera in forested ecosystems

Principal Cooperators:

Jeffrey Miller
Department of Entomology
Oregon State University
Corvallis, OR 97331

The objective is to establish a set of guidelines which would be implemented as a minimum for all evaluations concerning the impact of biological insecticide treatments on non-target species of Lepidoptera.

The literature has been reviewed for development of a bibliography, some specialists have been contacted for discussion of techniques used in 1994 and 1995, and a 15 page draft of the manuscript for the protocol manual prepared.

Funding: FY 1995: $24,100.

❷ Develop handbook of common caterpillars of western and eastern forests

Principal Cooperators:

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David Wagner
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University of Connecticut
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The objective is to develop handbooks of common caterpillars of western and eastern forests.

The handbook on common caterpillars of eastern forests (approx. 30 species) was published June 1995 (USDA Forest Service, FHM-NC-04-95). The handbook on common caterpillars of the Pacific Northwest (approx. 130 species that are associated with *Btk* treatments for gypsy moth and spruce budworm) is being edited (Forest Service, Radnor, PA) with a scheduled printing in early March 1996.

Both handbooks include a quality photo of the caterpillar stage of each species as well as biology and life history information.

Funding: FY 1995: $15,000.

Budget

	Dollars in thousands	
	NCFHM	Other Source
Completed Projects		
Biorational Methods		
❶ Gypsy moth mating disruption using disparlure	30.0	25.0
❷ Methods improvements for the nucleopolyhedrosis virus product Gypchek	21.0	28.6
❸ Develop insect growth regulator Mimic for managing forest defoliators	32.0	---
❹ Develop a technology transfer package for swath kits	35.0	---
Biological Controls		---
❶ Coordinate international efforts with USDA-APHIS and - ARS and IIBC to locate potential biological control agents for managing forest and urban pests	5.0	---
Ongoing Projects		
Biorational Methods		
❶ Protection of Red Cockaded Woodpecker cavity trees from Southern Pine Beetle with a Novel host compound (4-allyanisole) as bark beetle repellent	35.0	---
❷ Initiate registration process for Douglas-Fir Tussock Moth pheromone for mating disruption	-0-	---
❸ Biology, life history, and population dynamics studies of hemlock woolly adelgid (HWA).	7.4	---
Biological Controls		
❶ Coordinate biological control efforts to manage Cypress Aphid in Kenya	---	20.0
❷ Develop biological control programs with The People's Republic of China: mealybug, *Oracella acuta*, on slash pine in Quangdong Province	7.1	45.0
❸ Develop a biological control program for the woodwasp *Sirex noctilio* in South America	12.0	---
❹ Establishing natural enemies of hemlock woolly adelgid (HWA) in North America	45.0	---
Nontarget Effects		
❶ Determine non-target impacts from insecticide applications and gypsy moth defoliation	15.0	---
❷ Develop a database concerning impacts of biological insecticides to non-targets in forest ecosystems	20.0	---
❸ Monitor non-target Lepidoptera as part of the North Carolina Asian Gypsy Moth Eradication Project	---	30.0

New Projects		
Biorational Methods		
❶ Inventory of semiochemicals for forest and shade tree pests in North America	0	---
❷ Overview of the status for development of microbials and nematodes for forest and shade tree pests in North America	12.0	---
❸ Develop quality assurance/quality control (QA/QC) standards for pheromones	0	---
Biological Controls		
❶ Coordinate efforts with USDA-APHIS and - APHIS Biological Control Institute and International Institute for Biological Control to locate, evaluate and distribute potential biological control agents for managing forest and urban pests	---	---
❷ Biological control of noxious weeds in forest ecosystems	6.0	---
❸ Develop a pest management program (emphasis on biological control for *Tomicus piniperda* (Common Pine Shoot Beetle)	43.1	---
❹ Integrated control of *Cylindrocladium* root disease by using ectomycorrhizal fungi in combination with the microorganisms, a cover crop and soil amendment	40.1	---
Non-target Effects		
❶ Develop guidelines to determine non-target effects on Lepidoptera in forested ecosystems	24.1	---
❷ Develop handbook of common caterpillars of western and eastern forests	15.0	---

Publications

FY95

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